D-2 COLD WORK DIE STEEL

D-2 is an air hardening high carbon-high chromium cold work die steel offering excellent wear resistance. It is a deep hardening steel, and hardens with a minimum change in size and volume. **D-2** will exhibit somewhat better machining and grinding characteristics than the higher carbon type at only a slight sacrifice in abrasion resistance, and will also be superior in toughness and fatigue strength.

TYPICAL APPLICATIONS

Blanking dies, cold forming dies, drawing dies, lamination dies, thread rolling dies, shear blades, slitter knives, forming rolls, seaming rolls, burnishing tools, punches, gauges, knurls, wear parts.

PHYSICAL PROPERTIES

Critical temperature - (on heating) 1480*F
Specific gravity - 7.7
Coefficient of Thermal Expansion

100 - 500*F	**5.71 x 10-6 in/in/*F**
100 - 800*F	**6.63**
100 - 1000*F	**6.82**
100 - 1200*F	**6.85**

THERMAL PRACTICE

FORGING - Heating for forging must be done slowly and uniformly. Soak through at 1850-1950*F, and reheat as often as necessary, stopping work when the temperature drops below 1700*F. After forging cool slowly in lime, mica, dry ashes or furnace. **D-2** should always be annealed after forging.

ANNEALING - Heat slowly to 1550-1600*F, hold until the entire mass is heated through, and cool slowly in the furnace (40*F per hour) to about 1000*F, after which the cooling rate may be increased. Suitable precautions must be taken to prevent excessive carburization or decarburization.

STRAIN RELIEVING - When desirable to relieve the strains of machining, heat slowly to 1050-1250*F, allow to equalize, and then cool in still air.

PREHEAT FOR HARDENING - Warm slightly before charging into the preheat furnace, which should be operating at about 1400-1500*F.

HARDENING - After thorough preheating, transfer to the hardening furnace, operating from 1750-1850*F, depending on the degree of hardening desired for the application, and the size of the tool.

QUENCHING - **D2** is an air hardening steel, and will develop full hardness on cooling in still air. If the scaled surface resulting from air cooling is objectionable, the part may be quenched in oil until it has lost its color (1000-1200*F), and then allowed to cool in still air. Any necessary straightening should be done while cooling in the range of 850-450*F. Parts should be allowed to cool to 150*F, or to where they can be held in the bare hand, and then tempered immediately.

TEMPERING - The tempering temperature may be varied according to the desired hardness. If maximum hardness is desired, tempering should be in the range of 300-400*F, but if a lower hardness is acceptable, tempering at 950*F will give the optimum combination of hardness and toughness. The response to tempering is shown in the following chart.

	Air Quenched	
High Heat As	**1775*F**	**1825*F**
Quenched	**62.5 RC**	**63.5RC**
Tempered		
300*F	**61.5**	**62.0**
400*F	**60.0**	**61.0**
500*F	**58.5**	**59.0**
600*F	**57.5**	**58.5**
700*F	**57.5**	**58.0**
800*F	**58.0**	**59.0**
900*F	**58.0**	**59.0**
1000*F	**56.0**	**57.5**
1100*F	**51.0**	**53.0**
1200*F	**40.0**	**41.0**

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